Incorporating "The Illuminating Engineer."

Light and Lighting

Official Journal of the Illuminating Engineering Society.

32, Victoria St., London, S.W.1.

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Vol. XXXIV.—No. 2

February, 1941

PRICE NINEPENCE
Subscription 10/6 per annum, post free

Principal Contents:

	PAGE
Editorial Notes....	19
Notes and News	20
Fittings for Low Illuminations	22
Coloured Light Signals....	24
Headlamps for Motor Vehicles	26
Lamp Voltage Choice	28
Lighting Literature	30
The Editor Replies	33
Where to Buy	35

The Colour Scale

THE Illuminating Engineering Society has always been preoccupied with Colour—both with the colour of light-sources and with their influence on the appearance of coloured objects.

As far back as 1912—only the fourth year of existence of the Society—Mr. T. E. Ritchie read a paper on "Colour Discrimination by Artificial Light." He illustrated, in terms of visual effect and by the aid of photometric measurement and photography, the changes in appearance of coloured objects when viewed by the light of the illuminants then available.

To-day the variety of hues found amongst artificial illuminants is far greater and more striking. But we have made good progress towards the realisation of Standard Artificial Daylight, and the British Colour Council has produced a standard colour scale—a series of colour-tints, each precisely illustrated and described.

Yet many other colour charts are in use. In different sections of industry there is no common system of nomenclature.

We have, therefore, still to reach uniformity in the Standard Colour Scale, and when this is attained we have still to achieve what the I.E.S. has always desired—a means of portraying the changes in appearance of such standard colours when viewed by the chief artificial illuminants in common use.

This is one of the main questions before the newly constituted Colour Group, in which the I.E.S. is interested—a formidable problem. Good luck to them!

The Irony of War

In his annual report for 1939 the Chief Inspector of Factories (Mr. A. W. Garrett) comments on two examples of the irony of war. Whilst the modern housing estates have taken the factory workers away from the centre of the town into better surroundings this very fact has created a traffic problem in the black-out which has led to a prolongation of the working day and sapped the workers' energy. The fact that modern factory architecture has for some years developed towards the large window space, with great benefit to workers, has similarly reacted to their disadvantage under war conditions. For the provision of ample daylight has made the problem of securing an efficient black-out much more difficult than in the case of the older factories, badly equipped with window space. Lack of foresight resulted in a hasty effort to achieve complete obscuration of daylight at the outbreak of war. It appears that this fact was partly responsible for the remarkable increase in the number of fatal accidents recorded during the period September, 1939, to February, 1940, 685, as compared with 482 in the corresponding previous period—an increase of 42 per cent. A large proportion of this increase was in respect of persons falling, accidents due to falls through roofs in the rush to get black-out work completed being frequent. Reliance on artificial lighting (often imperfect) throughout the twenty-four hours had a definite depressing effect, and it has since become usual to secure some measure of natural lighting during the day by means of blinds and shutters. We must, however, look to the coming report for 1940 for a fair survey of lighting problems in war time. Mention is made of the "Fifth Report," issued by the Departmental Committee under the chairmanship of Sir Duncan Wilson, but the recommendations made therein and their effect on industrial lighting really fall within the 1940 period.

Fifty-fifty

It is something of an anomaly that in many areas ratepayers have to meet the cost of street lamps that are never lighted—only partly so, however, for there are certain items apart from the actual light which involve expenditure, such as maintenance, standing charges, and sinking fund contributions. The position is well illustrated by the reported agreement reached between a number of local authorities and the London and Home Counties Joint Electricity Authority, which maintains lamps in an area of about 190 square miles. It is proposed that the war-time charge should be 50 per cent. of the normal sum, which will roughly cover the standing charges mentioned above. This arrangement seems likely to meet with general acceptance.

Times of Meetings

I.E.S. sessional meetings in London have been held early (2.30 p.m.) in the afternoon during the winter and, on the whole, with success. Audiences have been good considering war conditions—certainly much better than could have been hoped for during the hours of darkness. Yet many members cannot leave their work at this early hour, and I.E.S. local centres have in general found it necessary to adopt times in the late afternoon or early evening—until circumstances, in some cases, made this impossible. With the extending hours of daylight the holding of some meetings during the early summer seems worth consideration, bearing in mind that many counter attractions available in time of peace do not now exist. The I.E.S. Midland Centre, with headquarters in Birmingham, is proposing to try this experiment, and the results of their enterprise will be watched with interest.

Mr. A. P. Trotter; I.E.S. Honorary Member

We learn that the President and Council of the I.E.S. have conferred on Mr. A. P. Trotter the rare distinction of "honorary membership." It is laid down in the Articles of the Society that honorary members "may be chosen from among those who are of acknowledged eminence in some branch of science relating to illuminating engineering, or who, by reason of position, eminence, or experience, have rendered, or may be enabled to render, assistance in promoting the objects of the Society." It is further specified in the by-laws that not more than one honorary member may be elected in any one year and that the total number at any time may not exceed six. Mr. Trotter is the only honorary member at the present moment. Readers will join us in expressing pleasure at this very fitting recognition of Mr. Trotter's great contributions to illuminating engineering and of his long and unique period of service to the objects which the Society has in view.

Next I.E.S. Meeting in London

The **next I.E.S. meeting** in London has now been arranged to take place in the lecture theatre of the E.L.M.A. Lighting Service Bureau (2, Savoy-hill, London, W.C.), at **2.30 p.m.** on **Tuesday, March 11.**

Summaries will be given of recent work in connection with various phases of **A.R.P. Lighting,** such as the design of illuminated **A.R.P. signs, motor car headlights,** and **fittings for providing low illumination** (0.002, 0.02, and 0.2 ft.c.).

The addresses will be illustrated by demonstrations, and numerous points of technical interest will be raised.

Lighting for Obscurity

The comments on this topic in our last issue* have led to some further suggestions, for example, in connection with the idea expressed in the final paragraph that attempts might be made to confuse the enemy by the deliberate use of light-beams emitted upwards. It has, we believe, been found in practice that even searchlights, directed upwards, do not produce sufficient glare to prevent observations from above, so that lesser lights are unlikely to do so. Allowance must here be made for the effect of distance.

The use of lights to deceive, which is in effect a form of night-camouflage, is a possibility that the authorities are unlikely to overlook—though one may doubt whether the conception of a sort of floating "fun city," brightly lighted in the hope that it may be mistaken for the British Isles, is likely to bear good fruit.

The suggestion that fighters should be equipped with portable searchlights seems more reasonable. It has recently been stated that the enemy is exploring this idea, which has been also the subject of study here. One obvious difficulty is that the use of such searchlights is apt to give away the position of the aircraft using them. When all this has been said, however, there seems good reason to advocate a little more generosity in the degree of artificial lighting permitted at night, at least at certain approved spots as contemplated in the recent Report on War-Time Street Lighting.† After all, there is a big gap between the existing value and moonlight, which is 100 times as great and is afforded us quite frequently by nature!

It has even been suggested that, having achieved synthetic star light, we might furnish ourselves with artificial moonlight derived from occasional directive sources of light mounted on balloons attached to cables and situated some thousands of feet above ground level. In this connection it may be noted that a source of only 25,000 c.p. (by no means remarkable in these days) would, at a height of 5,000 ft. produce 0.001 ft.c. at ground level. The resultant illumination, like moonlight, would fall on roads and roofs alike, but unlike the moon it would be subject to control.

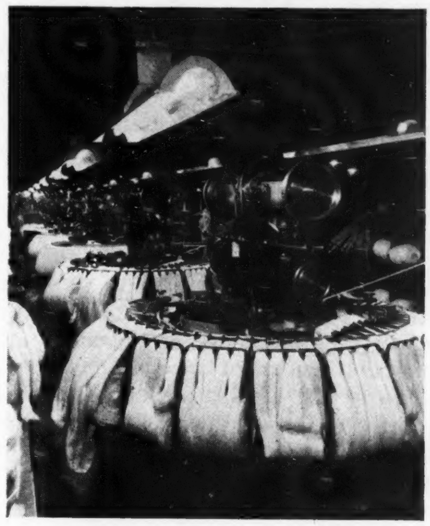
Traffic Accidents During 1940

The records of fatalities on the roads of Great Britain during the past year are now available. During the complete period 8,602 persons were killed. The number during December, 1,313, is the highest ever attained for one month. During October (1,012) and November (1,146) the thousand was also exceeded —a serious condition in view of the fact that the roads are so very much less used by the general public than in times of peace. In commenting on these figures previously we have pointed out the high proportion of accidents occurring during the blackout period. It would appear that in the recent winter months this proportion is somewhat less than in the corresponding period of the previous year—but this would naturally be expected when it is recalled that in the previous winter there was little experience of air raids, which have since diminished to an absolute minimum the use of the streets at night. The authorities report a general deterioration in care on the part of drivers. No doubt there is a tendency to drive at speeds beyond what is reasonable during blackout conditions. If a little alleviation of the blackout were found possible this should result in fewer fatalities—though even here there is the familiar difficulty that even a small addition to the light available may tempt people to take greater risks.

* "Light and Lighting," January, 1941, p. 3.
† "Light and Lighting," December, 1940, p. 196.

Fluorescent Lamps for Industrial Lighting

We have received from Mr. H. A. Purdie, one of the I.E.S. members in Australia, particulars of yet another instance in which the new fluorescent tubular lamps have been used with success in industry. The installation is shown in the accompanying photograph. The lamps are brought relatively near to the work and allotted to individual machines, so that the installation approaches what used to be termed "local lighting." The photograph clearly shows one of the strong points of this mode of lighting, the ability of the light, coming from an extensive and evenly bright luminous area, to "get round corners" and reveal details of complicated machinery. Mr. Purdie, whose firm (the "Lighting Centre," of Sydney) has been responsible for some of the earliest installations of this type in Australia, sends us other examples of its applications in stores, cocktail bars, etc.



An installation of fluorescent tubular lamps in a woollen mill in Australia. Each unit consumes 90 watts and furnishes 2,750 lumens. The illumination on the work is 40 ft.c.

Standards of Factory Lighting

History was made on the first of this month when the Factories (Standards of Lighting) Regulations, 1941, made by the Minister of Labour and National Service under Section 5 of the Factories Act, 1937, came into force.

The details of these requirements, which provide for a minimum working illumination of 6 ft.c. (subject to certain exceptions), were summarised recently in this journal.* It is to be noted that the Regulations apply only to factories in which persons are being regularly employed for more than forty-eight hours per week, or in shifts, but this will take in the generality of factories concerned with work of national importance. It will mark a great step forward if the adoption of these standards becomes general, even with this limitation. We have pointed out previously how vast is the work involved, but we hope that the effect will be made as widespread as possible. It is probable that in all the larger and more recently erected national factories, the conditions are already being more than satisfied. But it is quite as important, indeed possibly even more so, that requirements should be attained in the lesser factories throughout the country which, of course, are much more numerous.

* "Light and Lighting," Nov., 1940, p. 182.

Methods of Providing Low Values of Illumination[1]

(Not exceeding 0.002 foot-candle)

In what follows we give a summary of the revised version of BS/ARP16, one of the series of specifications prepared under the aegis of a Joint Committee of Ministry of Home Security and the Illuminating Engineering Society.

It will be recalled that very shortly after the outbreak of war, specifications for fittings to furnish 0.002, 0.02, and 0.2 ft.c., for exterior lighting in cases of essential work were prepared. Summaries of these specifications have appeared in this journal and in the I.E.S. Transactions ([2]).

Experience since gained has led to considerable extension and revision of the original specifications for fittings to furnish 0.002 ft.c. (BS/ARP/16). The main new features in the revised version, now issued, are the inclusion of a second type of fitting for closer spacing and the addition of an appendix containing useful hints on the use of these fittings.

The two types of fittings now illustrated are intended for relatively wide spacing (minimum spacing/height ratio 4:1), and relatively close spacing (minimum spacing/height ratio 2:1).

Fundamental Requirements.

The fundamental requirements, with which fittings of both types should comply, are as follows:—

(*a*) The fittings shall not emit any measurable light above 5° below the horizontal.

(*b*) When the fittings are installed as recommended by the manufacturer, a reasonably uniform illumination of approximately 0.002 ft.c. on a horizontal surface at ground level shall be provided.

(*c*) In order to prevent light from fittings situated at the end of a row escaping into extraneous areas or unduly illuminating vertical surfaces in their vicinity, suitable screens for attachment to such fittings shall be available.

(*d*) If adopted for conversion purposes, each fitting (with an adaptor where necessary) shall be capable of insertion in or attachment to the existing electric holder or gas fitting. Care must be taken to ensure that the combination will operate satisfactorily with the fitting to which it is to be attached.

(*e*) The construction of lighting fittings complying with this specification shall be such as to ensure adequate robustness and durability under normal conditions of use out of doors.

Fittings conforming to the descriptions given below shall be designated IES/ARP/0.002, and shall be indelibly marked with the power of the light source (wattage of electric lamp or size of gas mantle), the corresponding mounting height, and the recommended spacing.

Specimens of Fittings.

Any design fulfilling the fundamental conditions specified above may be adopted. For guidance, however, descriptions of approved electrical and gas fittings, both for close and wide spacing, are included in the specification. It is explained that the sketches indicate how the desired distribution of light may be attained, without reference to any mechanical features necessary to give protection against the weather.

The fittings for close spacing are substantially similar to those illustrated in the original specification, the chief difference being, in the case of the electrical fitting, the specification of the reflecting power, with a tolerance for the three mounting heights (10, 15, and 20 feet), without any effort to present, by specimens, the actual tints.

End Shields for Fittings.

Attention is, however, drawn to a new point—the fact that trouble is liable to be caused by the spillage of light beyond the boundaries of the area which fittings are intended to illuminate. The escape of this stray light can best be obviated by the use of an appropriate screen, to be applied to the end fittings only. An illustration of a possible screen of this type is reproduced in the specification.

Fittings for Close Spacing.

In the case of the gas fitting for close spacing the desired conditions can be obtained very simply, merely by modifying slightly the original design, making use of similar parts and employing three mantles of the same consumption as for the wide spacing units, corresponding to the three heights of suspension.

In the case of the electrical unit, however, the departure from the original wide spacing design is somewhat more marked. The same size of lamp (15 watts) is again used throughout, but the coating of the inside of the shade with white vitreous enamel is now specified. Special masks consisting of one sheet of opal glass with black perforated sheet, two sheets of opal glass, and one sheet of opal glass are adopted for the heights of 10, 15, and 20 ft. respectively. This procedure replaces the method based on variation in the reflecting power of the inner surface of the reflector, adopted for the wide spacing unit.

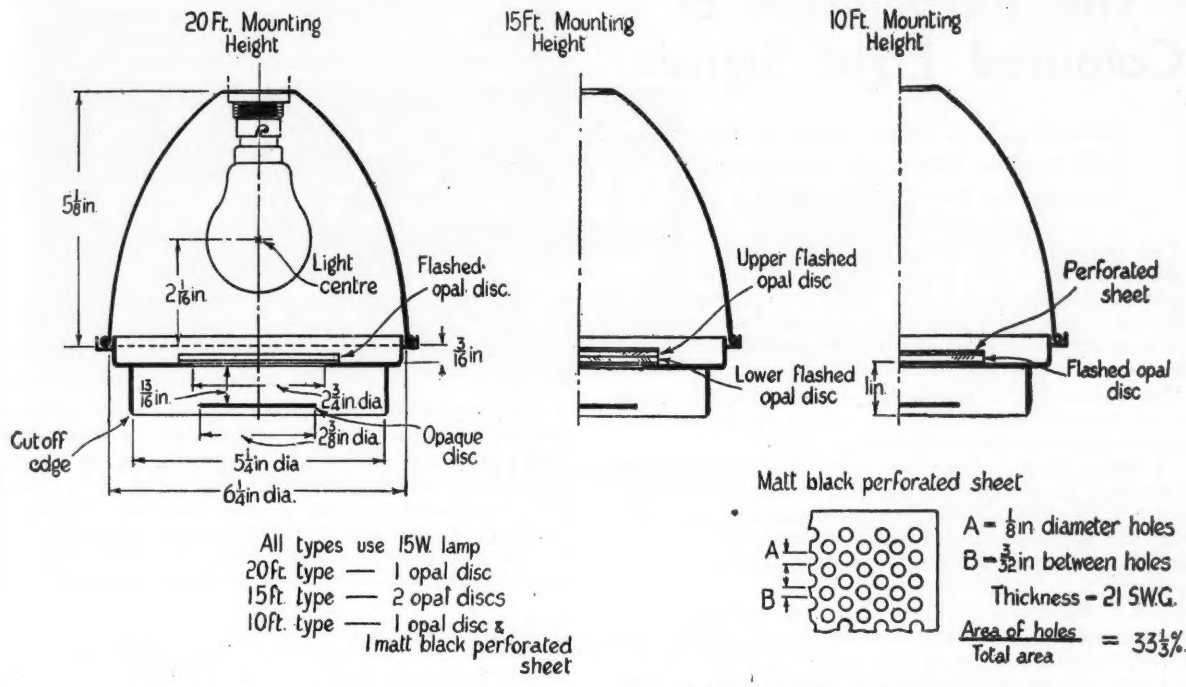
The nature of the conditions to be met is indicated in the accompanying illustration.

Hints on Use of Fittings.

Not the least useful element in the revised specification is the series of hints on the use of fittings, incorporated in the appendix. Attention is drawn to the fact that fittings should be maintained rigidly with their axes vertical, and should not be allowed to swing. Otherwise light may be seen from above and the uniformity of illumination at ground level impaired. Reference is again made to the need for screens to prevent stray light from end fittings. Objects very near the fittings, such as the upper parts of poles or supports, may with advantage be darkened with a view to diminishing their brightness. End-shields should not be necessary with fittings of the close spacing type. When fittings are used in the vicinity of water they should be so placed and screened that reflections of the sources in the water are, so far as possible, eliminated.

Importance is attached to close adherence to the terms of the specification and to maintenance of fittings in good condition. Standard lamps and mantles should be used, and the spacing of the units should

(1) Available from the British Standards Institution, 28, Victoria-street, London. S.W.1, price 6d., post free 8d.
(2) "Light and Lighting," September, 1939, p. 185. Trans. Illum. Eng. Soc. (London), September, 1939, p. 130.



ELECTRIC FITTING (IES/ARP/0.002) FOR CLOSE SPACING (2:1) GIVING CIRCULAR LIGHT DISTRIBUTION FOR GENERAL LIGHTING.

not materially exceed the specified minimum. In cases where the exact mounting heights of 10, 15 and 20 ft. cannot be attained, suitable ranges of height (9-14 ft., 14-19 ft., and 9 ft. and upwards) are suggested.

Attention is drawn to the importance of contrast at this low order of illumination. Obstacles liable to cause persons to stumble should be coated with white paint, and the edges of platforms and boundaries to water with white paint should be similarly treated.

In conclusion it is recalled that whilst the fittings described in the specification are presented as examples of devices fulfilling the essential conditions, other methods may be adopted. Preference should, however, be given to those methods which achieve the desired result in the most economical manner, i.e., by using sources of low power rather than by reducing the candlepower of relatively high power sources of obscuration.

Illumination and the Eye

We learn that the North Midland Local Centre has made arrangements with Dr. W. J. Wellwood Ferguson, who is a recognised authority on vision, to lecture at a forthcoming meeting on March 10. We hope to make further reference to this address in due course. Even before the outbreak of war there was evidence of a definite tendency on the part of illuminating engineers to concentrate attention on the behaviour and needs of the eye, on which the design of successful lighting installations is ultimately based. The subsequent black-out has brought home facts about the behaviour of the eye at very low illuminations, on which several instructive contributions have recently been made, notably by Dr. W. D. Wright, at the recent meeting in London on January 14, and by Mr. Waldram and his colleagues, in connection with their demonstrations of contrast last year.

Sports Under Artificial Light in New Zealand

Although war-time conditions naturally prevent the floodlighting of sports grounds in this country, it is refreshing to hear of parts of the British Empire where no such limitation is necessary.

The accompanying illustration, furnished by the General Electric Company, Ltd., shows the floodlighting of a sports field at Lower Hutt, New Zealand, which is being used for all kinds of night-time sports and athletic meetings. Rugby matches, it is said, can be arranged just as well as by daylight. The field is illuminated by twenty-eight G.E.C. floodlights on steel lattice towers 80 ft. high. All units are equipped with 1,500-watt incandescent lamps.

View of Sports Ground at Lower Hutt in New Zealand illuminated by floodlights on steel lattice towers.

The Recognition of Coloured Light Signals

Summary of a paper read by Mr. J. G. Holmes before the Illuminating Engineering Society on February 11.

The paper on the above subject, read by Mr. Holmes at the I.E.S. meeting held at the E.L.M.A. Lighting Service Bureau on February 11, contained a record of some very complete and painstaking work, and is to appear in full in the "Transactions" of the Society.

The paper was illustrated by a considerable number of lantern slides showing colour diagrams, and was divided into two main parts.

Of these, Part 1 described the construction and calibration of a laboratory apparatus which combines light beams transmitted through colour filters in such proportions as to reproduce the intensity and energy distributions of all the coloured light signals used in practice.

Part 2 discussed the technique of signal colour recognition and gave the results of over 40,000 observations, in the form of charts on which are drawn contours of the frequency of recognition of the simple colours under different conditions of illumination, range of possible colours, etc.

Apparatus

The apparatus described in Part 1 of this paper was made to provide a spot of coloured light suitable for observation under conditions comparable with night signalling and capable of variation through a wide range of colours whose energy distributions were similar to those of the usual signalling colours. Various experimental methods were tried, and finally an apparatus was built similar to the Donaldson colorimeter, but with eleven primaries. Eleven beams of light from a common light source were passed through colour filters and through adjustable apertures before being mixed in an integrator, and any required colour was obtained by combining the appropriate amounts of the three nearest primary beams. The range of colours covered the spectrum from extreme red to emerald green (550 mm.) and the area enclosed by this spectrum and turquoise, royal blue, and purple, with provision for particular consideration of white and yellow. The calibration was given extreme care with a view to eliminating relative error between similar colours, and so to allow of statistical examination of the results.

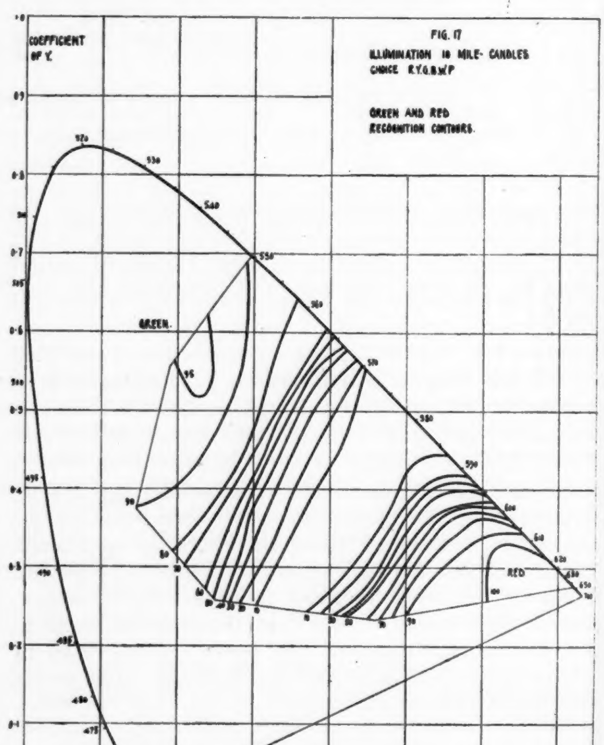
The test colours were obtained by the use of stencils selecting the primary beams, which gave 256 points on the colour chart, all being the same luminous intensity and brightness and each having a closely similar energy distribution to that which would be given by the corresponding colour filter which would be used in practice.

Method of Experiment

The method of experiment was to show the 256 colours in random succession to an observer who was asked to give one of the simple names—red, yellow, green, blue, purple, or white—to each test colour. This experiment was repeated for fifty observers, all of normal colour vision, and thus the number of times that any particular colour was given a particular name was found. Contours were then drawn on the colour chart showing the percentage frequency with which these simple names occurred over the whole area covered by the apparatus. The illustration is typical, and shows the distribution of the names red and green for an illumination of 10 sea-mile candles at the observer. The experiment was further repeated with six observers selected to give average results, each making three observations at four different illumination levels (1, 6, 100, and 3,400 sea-mile candles) and with several different choices of names, such as red, green, or white, and red, yellow, green or white, and so on, and contours were drawn for each set of conditions. Experiments were carried out to the effect of a comparison light, light adaptation, and presbiopic vision, and altogether some 43,000 observations have been analysed and are represented in the diagrams.

Summary of Results

The results are difficult to summarise, as the experiments were intended as a contribution to knowledge of colour recognition rather than a complete statement of the distribution of colour names. Red is the ideal signalling colour, being easily produced and yet recognised down to the lowest illuminations even when not fully saturated. Green is satisfactory under usual conditions, but must be considerably restricted if blue is also used for signalling. Blue and purple cannot be regarded as satisfactory, the former requiring very high intensity and the latter depending on the dichromatic aberrations in



the eye. Yellow and white are satisfactory if used separately, but they cannot be used together unless the white approximates to daylight. It may be noted that whereas yellow has often been thought unsatisfactory because of confusion with white, the case is really that many "whites" are unsatisfactory because they are themselves too yellow. No significant difference was found between monochromatic sodium light and the equivalent lamp and filter combination. Presbiopic vision and light adaptation both assisted the recognition of blue and purple signals.

The paper was concluded by a calculation of the optimum transmission factor for green colour filters based on the results obtained, and gives results which are reasonably consistent with those adopted in practice.

Headlamp Masks for Motor Vehicles (BS/ARP 36)*

Summary of a British Standard Specification, prepared under the ægis of a Joint Committee of the Ministry of Home Security and the Illuminating Engineering Society, and issued by the British Standards Institution at the request of the Ministry of Home Security.

1. **Scope.** This Specification lays down requirements for A.R.P. headlamp masks for motor vehicles. A headlamp mask conforming to this Specification will secure compliance with the Lighting (Restrictions) Order when the mask is properly fitted to a test headlamp (Clause 4) correctly adjusted on the motor vehicle and fitted with a bulb of the correct voltage and wattage rating. (This test headlamp is representative of a large proportion of the headlamps in use on motor vehicles other than public service vehicles.)

The Specification, however, goes beyond the requirements of the Order in that it defines not only the maximum illumination, but also certain minimum illumination values, together with certain constructional requirements.

2. **General Construction.** The construction of masks complying with this Specification shall be such that:—

(a) Those parts which control the optical properties are not liable to variation or derangement in maintenance or use, and (b) the materials and construction are robust, and are not subject to such variation in service as to be likely to bring the photometric performance outside the limits laid down in Clause 3.

Any translucent material, other than that for the auxiliary aperture of a dual-purpose mask, shall be of glass of adequate mechanical strength. (1) The mask shall not modify appreciably the colour of the light emitted by the headlamp. When the mask is correctly fitted to a headlamp no light is emitted except through the mask.

The following particulars shall be marked (2) on the mask: (1) Rated voltage and wattage of lamp to be used; (2) name or trade mark of manufacturer; (3) A marking, e.g., the word "top," to indicate the correct position of the mask relative to the headlamp; (4) if the alignment of the axis of the headlamp when fitted with the mask is not intended to be horizontal, the amount of tilt shall be marked, e.g., "5° downwards."

3. **Photometric Performance of Mask.** The photometric performance of the combined unit formed by the mask correctly fitted to the test headlamp shall comply with the following requirements when tested in accordance with Clause 4. For the purpose of this Clause and of Clause 4, the auxiliary aperture in a dual-purpose mask shall be obstructed by opaque material.

The angles of emission referred to below relate to the condition in which the combined unit is aligned so that: (a) the axis of the headlamp is horizontal or is tilted by the amount specified on the mask (see Clause 2, item (4); and (b) the plane containing the V filament of the bulb is either horizontal or intersects the horizontal plane in a line at right angles to the axis of the headlamp. The angles shall be measured with respect to an origin located at the centre of the aperture of the headlamp. The direction of maximum emission shall be in a vertical plane making an angle of not more than 5° with the vertical plane containing the axis of the headlamp.

The illumination measured on a spherical surface of radius 10 ft. with its centre at the centre of the headlamp aperture:

(i) Shall not exceed 2.5 f.c. at any angle of emission; (ii) shall be not less than 1.25 f.c. at the angle of emission giving the maximum illumination.

For directions of emission, in any vertical plane, making an angle equal to or greater than $\alpha°$ relative to the horizontal, the illumination shall not exceed β f.c., where α and β have the values given in the following table:—

α	β
1° above horizontal	0.01 f.c.
5° ,, ,,	0.001 f.c.
12° below ,,	0.1 f.c.
20° ,, ,,	0.02 f.c.

In a plane containing the direction of maximum emission and the horizontal directions at right angles to the axis of the headlamp, the illumination within an angle of 20° at either side of the forward direction shall be not less than one-twelfth of the maximum illumination.

4. **Method of Test for Photometric Performance.** The test headlamp (3) shall consist of a parabolic mirror of focal length approximately 1.2 in., and having a front aperture of 7 in. diameter, together with a clear automobile bulb having a V filament. The bulb shall be mounted so that the axis of the filament coincides as nearly as possible with the axis of the mirror, and the position of the filament is such that the beam has minimum divergence. The mask shall be mounted with its back-plate normal to the axis of the mirror; and not more than ¼ in. in front of the aperture. (4).

The photometric test shall be made with a lamp having a rated voltage of 6 or 12 volts, according to the voltage marked on the mask. The voltage across the lamp during the photometric measurements shall be adjusted as closely as possible to the rated voltage of the lamp. The total lumens emitted by the test headlamp with the mask removed shall be measured.

The illumination readings obtained with the mask in position shall be corrected by a factor equal to the ratio of the total lumens as measured to the standard total lumens given in the following table:—

Rating of bulb.	Standard total lumens from test headlamp without mask.
6 V 24 W	330
6 V 36 W	550
12 V 36 W	610

Compliance with Clause 3 shall be determined on the basis of the illumination readings corrected as described above.

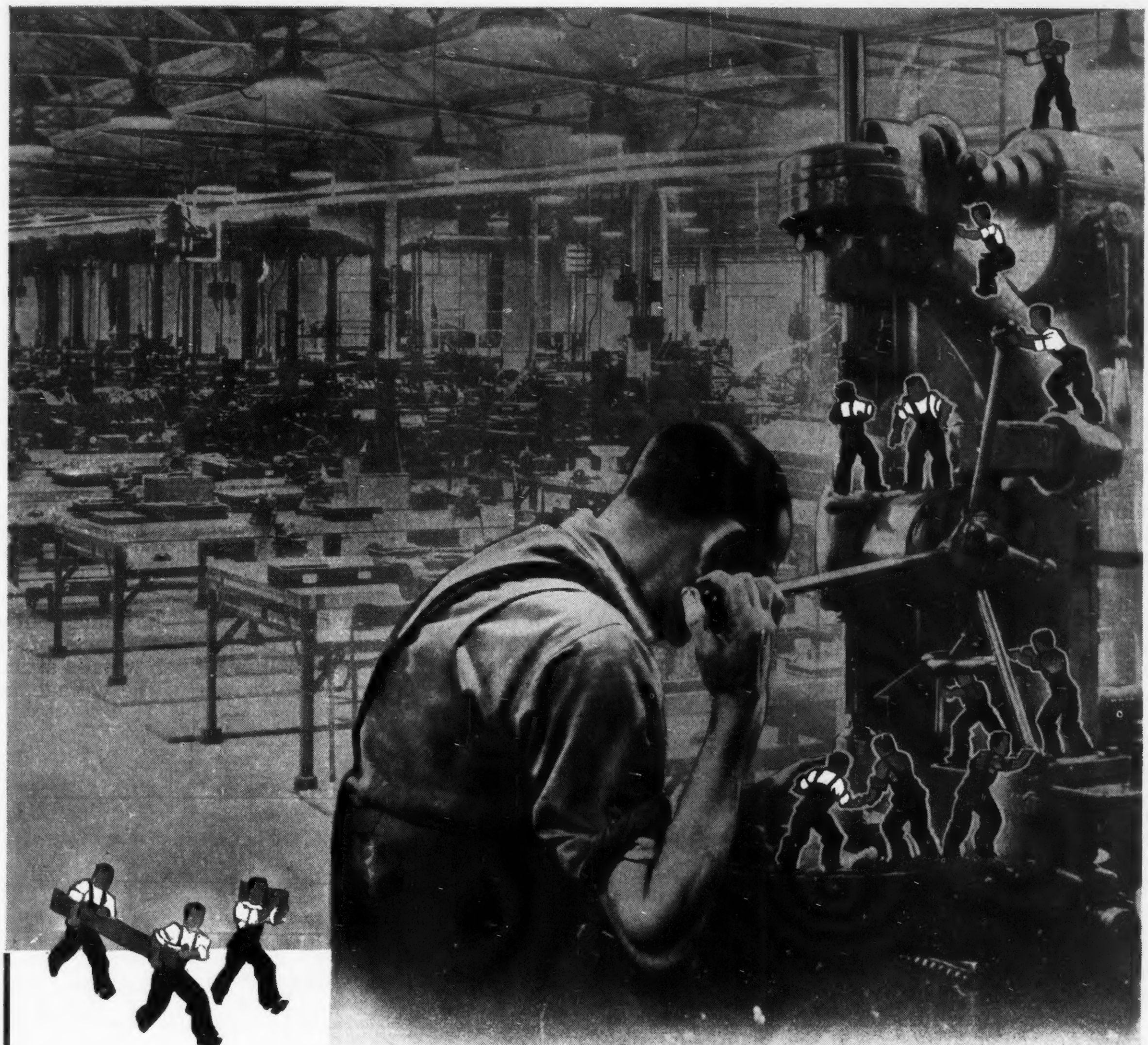
(1) The use of other materials is under consideration, but until a Supplementary Specification for such materials is issued by the B.S.I., glass is the only translucent material recognised as complying with Clause 2.

(2) Licensed Manufacturers may add the B.S.I. Certification Mark. Particulars of the conditions under which licences for the use of the mark may be granted may be obtained on application to the Director, British Standards Institution.

(3) A Lucas headlamp No. M. 140 with its front glass removed provides a test headlamp complying closely with the specification given in Clause 4.

(4) In the case of a mask having an inclined back-plate the test shall be made on a special model, modified as regards the back-plate so that it can be fitted to the test headlamp.

* Obtainable from the British Standards Institution (28, Victoria Street, London, S.W.1); price 2d., post free 4d.



The Economics of Lamp Voltage Choice

By ALAN H. OWEN

Summary of a paper read before the I.E.S., North Western Centre.

In spite of the remarkable progress made in luminescent illumination, the incandescent lamp, with its great variety of sizes and types, its low cost and simplicity of installation and operation, has yet to be seriously challenged. Its comparative inefficiency, however, makes it imperative that we should be constantly on the look-out for an alternative light source.

Theoretically, if power could be transformed into light of wavelength of 556 milli-microns—at which point the retina of the eye would be most effectively excited—about 670 lumens per watt would be obtained. The light would be monochromatic and yellow-green—unsuitable for general illumination. The theoretical maximum of the ideal source emitting a continuous visible spectrum resembling that of daylight would be about 250 lumens per watt. It is therefore apparent that 92% of the energy necessary to operate the most efficient 1,000-hour lamp at 20 lumens per watt is wasted in useless radiation. The value of the 8% of energy which is utilisable for light should be appreciated and it should be economically employed.

In this country people generally take pleasure in purchasing goods of quality. In the case of lamps, however, things seem to be different, perhaps because our experience in purchasing this useful commodity is too short. We and our ancestors have been buying most things for a hundred years or more, but lamps for only a little over a generation.

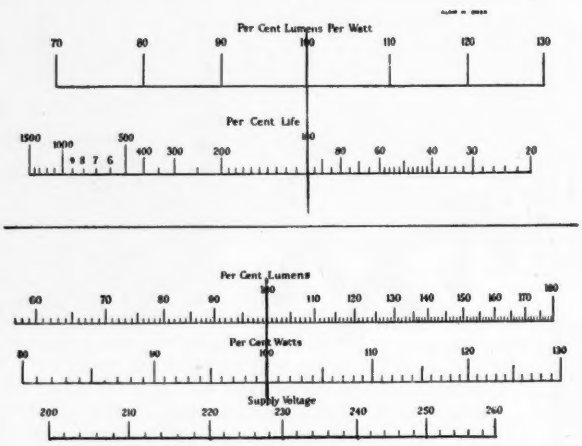
Lamp-life seems generally to be identified with quality, yet lamp-life is the easiest of all the "quality-points" for any manufacturer to attain. There are no technical difficulties in manufacturing lamps with an average life of 10 hours or 10,000 hours. Indeed, it is easier to manufacture the latter than the former.

Investigation on tungsten powders, wire, coiling, exhausting, gas, and machinery have enabled manufacturers to improve efficiencies to a marked degree, but the most important quality-point, and probably the most difficult for the mainufacturer to attain, is uniform efficiency and performance.

"Survivor curves" of lamps are well known. Vertically they show the number of lamps still living at any time, and horizontally the number of hours. In this connection Mr. Owen showed two theoretical curves, one exhibiting an 8% average spread and the other a 2%. The two batches of lamps behaved very differently. Early failures due to defects in manufacture occur in the 8% batch. At 750 hours 18% have failed, whereas in the case of the 2% batch it is at this point that the first lamp burns out. At 1,500 hours there are no lamps left in the 2% batch, while 40% of the 8% batch still survive. These obviously have a very low efficiency, and some of them linger on to 3,000 hours or more. These appear to be a bad lot. Yet there are millions of lamps being bought in this country whose performance is similar and even worse than this. On the other hand, many British manufacturers are making lamps to the close rating as shown on the 2% curve. In fact, in the case of those sizes of lamps whose filaments can be automatically mounted—40 watts to 150 watts—an even steeper curve is made—not more than a 1% spread. A graph shown relating to an actual test on the performance of a dozen 230 volt 60 watt Coiled Coil lamps showed three failures before 1,000 hours; the first at 840 hours, and nine failures after 1,000 hours; not a lamp left at 1,210 hours. The average life of batch was 1,062 hours. Mr. Owen pointed out that according to the survivor curves shown the 8% batch had an average life of 1,500 hours, against the 1,000 hours of the 2%. Yet his experience was that the 8% manufacturer of the 1,500-hour lamp had more complaints regarding short life alone than had the 2% manufacture of the 1,000-hour lamp!

Lamps made to a close tolerance, of known life, efficiency, and performance, should be operated at the most economical life. For instance, it is waste of energy for a church, paying 4½d. a unit for its supply, and burning lamps for about two hours each Sunday during six months in the year, to operate lamps of 1,000-hour life. On the other hand, a colliery burning lamps for twenty-four hours each day and energy costs at ½d. a unit must have a longer life than 1,000 hours.

The average life of a lamp is inversely proportional to the 13.1th power of the volts. The lumen output is directly proportional to the 3.38th power of the volts. The efficiency in lumens per watt is strictly proportional to the 1.84th power of the voltage, and



the current is directly proportional to the 0.541th power of the volts. These relations give reasonably accurate results over a not too wide range of efficiency.

For simplicity these can be worked out on a slide-rule principle. (See Fig.) Lamp voltage opposite the corresponding supply voltage gives 100% watts, 100% lumens, 100% life, and 100% lumens per watt. Moving 240-volt lamps to 230-volt supply gives 93% watts, 85% lumens, 180% life, and 91.5 lumens per watt. Similarly, one can show the results of operating 250, 210, and 220-volt lamps on a 230-volt circuit.

Mr. Owen then gave one or two actual experiences of cases where lamps have been successfully operated at other than their rated voltage. It was previously mentioned that many lamps in churches are used as little as fifty hours a year. Under such conditions a 1,000-hour lamp has a life of twenty years. With current at 4½d. a unit it will be agreed that this is a great waste of energy. Operating 210-volt lamps on a 230 circuit the slide rule shows lumens to have increased to 136% against watts only 114%. Life is reduced to 33%, i.e., 330 hours. Incidentally, a very useful life indeed of 6½ years.

At a large church, where artificial light had to be used at every service (but even so, the total burning hours of the lamps did not reach 200 hours a year),

readings were taken at 18 points, and the average reading at pew levels was 4.47 ft.c. The 230-volt lamps were changed for 210-volt of the same wattages, and the new readings showed an average of 7.42 ft.c.

An engineer in a cotton mill was instructed by his manager to increase the illumination in one of the rooms which contained 70-200-watt lamps in industrial reflectors. Something had to be done quickly, as an important order had to be got out against time. The engineer had his troubles. He did not want to alter his holders and reflectors to take 300-watt lamps, and his plant was heavily overloaded, anyway. He decided to substitute 220-volt lamps for his 230-volt ones. As a result, 16% more light was obtained with the addition of only 6½% on the wattage.

Finally, an extreme case at the other end of the scale was mentioned. An engineer at a large mental hospital was very worried. His committee insisted that he bought the cheapest of everything—lamps especially. Lamp replacements were certainly very heavy, but when investigations were made it was found that the chief cause of the trouble was that, in the extensive corridors, lamps were burning twenty-four hours each day, winter and summer. While the committee were concerned at lamp replacement costs, the engineer's difficulty was the continuous call on his staff in replacing each lamp as it failed. Power costs were low and the plant well under load. The trouble ceased when 120-volt lamps replaced the 105-volt in the corridors. The wattage of the latter had been 40. In order to obtain approximately the same light, 120-volt 60-watt lamps were used. At 105-volt supply the actual wattage would be 48.5, and the life of the lamps averaged over 8,000 hours. Everyone was happy—except, of course, the lamp manufacturer!

Industrial Lighting in the Blackout

The paper by Mr. R. Maxted on this subject* was read before the I.E.S. local sub-centre in Nottingham on January 31, Professor H. Cotton presiding.

About thirty-five members and friends were present. The audience included several of H.M. Inspectors of Factories, who took part in the discussion. Professor Cotton, after congratulating the author on his paper, emphasised the importance of "suitability" as well as the provision of adequate illumination. He pointed out, for example, how the presence of glare, which led to protective closing of the pupil aperture, prevented the eye from getting the full benefit of the light provided and inevitably produced fatigue and eyestrain. Miss Bradley and Mr. Woofenden, as inspectors of factories, confirmed the importance of good illumination and the value of *quality* of lighting. Miss Bradley urged that factory executives should be led to take more interest in lighting problems. She also discussed the special difficulties prevailing at the present moment, pointing out the necessity for conserving resources when planning new installations. So far as possible old material should be utilised, in view of the magnitude of the task. Mr. Woofenden drew attention to the need for glasses and special aids to vision in certain operations—which even the best lighting could not render superfluous. Mr. C. S. Caunt, honorary secretary of the centre, expressed his interest in the author's exposition of the merits of the new 5 ft. fluorescent lamp, and suggested that Mr. Maxted should give those present a little information on such points as colour matching, stroboscopic effect and efficiency. After Mr. Maxted had replied to the discussion a vote of thanks to the lecturer, proposed by Mr. R. G. Payne, was carried with acclamation.

* We have already given a summary of this paper ("Light and Lighting," Nov. 1940, p. 188) which will appear in full in the "Transactions."

Reviews of Books

The "Gas Journal" Calendar and Directory. (Walter King, Ltd., London, 1941; pp. 244 + xxxii.)

This useful handbook makes its appearance once more in spite of the present difficult circumstances. The familiar and comprehensive list of gas undertakings in the United Kingdom and Overseas forms the greater part of the Directory proper. To these must be added the list of public lighting engineers in various localities, and the record of gas and allied organisations. The handbook reviews the growth of the gas industry up till 1938, which makes an impressive showing. Conditions since the outbreak of war have, naturally, not been so happy. There is also a variety of contributions, occupying about 100 pages, terminating with the Gas Engineer's Bookshelf, which covers a very wide ground. It is, in the present circumstances, perhaps excusable, but (as we have previously pointed out) anomalous, that not one of these contributions deals in any way with lighting. It seems likewise an omission that the Gas Engineer's Bookshelf, though equipped with a good stock of volumes dealing with such ancillary subjects as concrete, structural steelwork, civil engineering, and building construction, apparently lacks any books dealing with photometry or illumination. But no doubt this will be rectified in a future edition.

Textbook on Light. By R. W. Stewart and J. Satterly; revised by C. T. Archer. (University Tutorial Press, Ltd., London, 1941; pp. 366, figs. 249. 7s. 6d. net.)

This textbook, now in its second edition, is intended for students preparing for the London University "Intermediate" examinations, and contains a treatment of the elements of geometrical optics. The original subject matter has been rearranged, and many parts have been rewritten in the course of the revision effected by Professor C. T. Archer. The earlier chapters follow familiar ground in dealing with fundamentals, reflection and refraction, lenses and optical instruments. Later chapters deal with photometry, the theory of light, interference, diffraction and polarisation, and spectra. The treatment of spectra is an additional item, and the chapter on photometry has been rewritten and brought up to date—though we notice, as is not unusual in textbooks on light, that relatively little attention is devoted to the measurement of illumination and to the latest forms of instruments, such as those of the photoelectric type. At the end of the book is a series of exercises for students.

Modern Factory Lighting. (Issued by the British Electrical Development Association and the E.L.M.A. Lighting Service Bureau, London, 1940; pp. 139.)

The recent appearance of a third impression affords us another opportunity of referring to this publication. The edition before us has been slightly modified to include reference to the new fluorescent tubular lamps. It will be recalled that the book contains chapters on the Purpose of Factory Lighting, Factory Lighting Legislation, The Choice of Light Sources, The Design of Interior Lighting Installations, Special Industrial Lighting Problems, and War-Time Control of Factory Lighting. It is illustrated by many effective sketches and photographs elucidating special problems in industrial lighting. The chapters reviewing legislation and war-time regulations are particularly helpful, especially in view of the fact that the chief provisions of the Fifth Report have now been definitely incorporated in lighting legislation. The various appendices contain other useful matter, such as the series of graphical symbols for use in plans of interior wiring installations, data on lamps, fusing currents, conversion tables, etc., and a summary of recent scientific investigations into lighting in industry.

No. 475857. "Improvements in Lamp Reflectors."

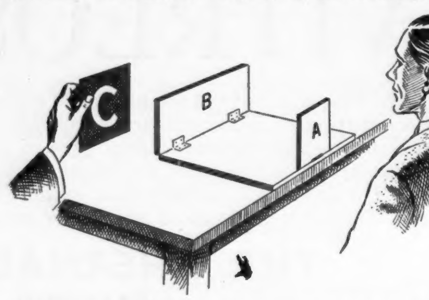
The owner of the above patent is desirous of arranging, by licence or otherwise, on reasonable terms, for the manufacture and commercial development of the invention. For particulars address in the first instance to Herbert Haddan and Co., 31 and 32, Bedford-street, Strand, London, W.C.2.

Tests for Night Vision

It will be recalled that in his recent paper before the Illuminating Engineering Society Dr. W. D. Wright referred to the importance of night vision in the present circumstances. People differ greatly in their ability to see their way about in twilight. Some who have otherwise fairly good sight may be quite at a loss in the obscurity which now enshrouds our streets by night. It is clearly desirable that people who have marked disability in this respect should not be entrusted with responsible duties that have to be undertaken in darkness—should not, for example, attempt to drive motor vehicles by night.

It is a singular thing that until recently there appears to have been no accredited method of testing capacity for night vision. Dr. Wright has, however, devised a simple form of testing apparatus, which is now being supplied by Sir Isaac Pitman and Sons, Ltd.

This consists of a wooden container which can be opened out as shown in the accompanying illustration. In A a small disc of radium luminous compound provides a faint source of light which shines through a Cellophane window on to B. Against B any one of nine cards can be placed, each card consisting of a broken circle printed in grey on a black background. The degree of grey is, however, graduated, and



the observer is asked to discover which card can just be seen, the test being conducted in complete darkness except for the small light at A. The observer should view the card from a distance of about twelve inches, and should have been in complete darkness for fifteen minutes before a final effort is made to determine which of the series of cards can just be seen. Of the nine cards available No. 7 is taken as standard. Experiments show that about 49 per cent. of people can just see this card, whereas 20 per cent. can only see No. 6, and about 6.5 per cent. can only see No. 5. On the other hand, a very small minority, about 1.5 per cent., can see cards as dark or darker than No. 9. If only No. 1 can be seen the observer is estimated to need ten times as much light as the normal. Other figures are assessed for intermediate cards (Nos. 2 to 7), whereas if No. 8 and No. 9 can be seen, the light required is only 1/2 and 1/4 respectively.

Besides the primary purpose of ascertaining general capacity for night vision the test can also be applied to ascertain how long an observer requires to become dark-adapted—another important factor which varies in different individuals.

Light Rays (Visible and Invisible) for War Protection

Some literature received recently from Radiovisor Parent, Ltd., reminds us of the special applications of detective devices, operated by visible or invisible rays, during wartime.

An installation of invisible rays can be arranged to give warning whenever an intruder strays within a given area, and without his being aware of the fact. It is, therefore, a valuable addition to the patrol. A distance of about 170 feet to 200 feet can be covered in this way, and important points of entry can be readily controlled.

Of special interest at the moment is the light-ray incendiary bomb protector. Incendiary bombs usually come to rest in the top-floor rooms and ignite on contact, burning with an intense light which is readily detected by a light selenium cell and relay circuit. The warning can thus be given in any convenient and relatively remote room to the person on guard, whose assistance can thus be quickly secured without its being necessary for him to be continuously in the open. It is estimated that a single set will react to direct or reflect light anywhere within a radius of 30 to 40 feet. A repetition of such devices should, therefore, suffice to give warning of the arrival of bombs anywhere over the top floor of an extensive building. The control unit is designed to give alarm if the mains fail or the valve burns out or loses efficiency, so that the user cannot remain in a state of false security.

The Equipment of the Milk Marketing Board Headquarters

The accompanying illustration shows the lighting of the board room at the headquarters of the Milk Marketing Board. In other sections of the building it is of an equally up to date character, the illumination in foot-candles in each department being adapted to the work involved. A number of spherical fittings in bronze are installed. In the entrance hall, the board room, and certain executive offices special lighting features have been included Fluorescent tubing is installed in the entrance hall and cafeteria. In the board room decorative rectangular fittings are combined with an extensive lay-light. The lighting fittings were supplied by the General Electric Company, Ltd., who were also responsible for the private automatic telephone system, the "Reliance" watchman's clock system, the refrigeration equipment for the canteen, and other special equipment.

The normal demand for the premises is about 450 kW. Arrangements are made for certain departments to be able to switch over from A.C. to D.C., or vice versa, at short notice. In all about 75,000 yards of cable of various sizes have been installed.

The lighting of the Board Room of the Milk Marketing Board Headquarters in which rectangular fittings are set round an extensive laylight.

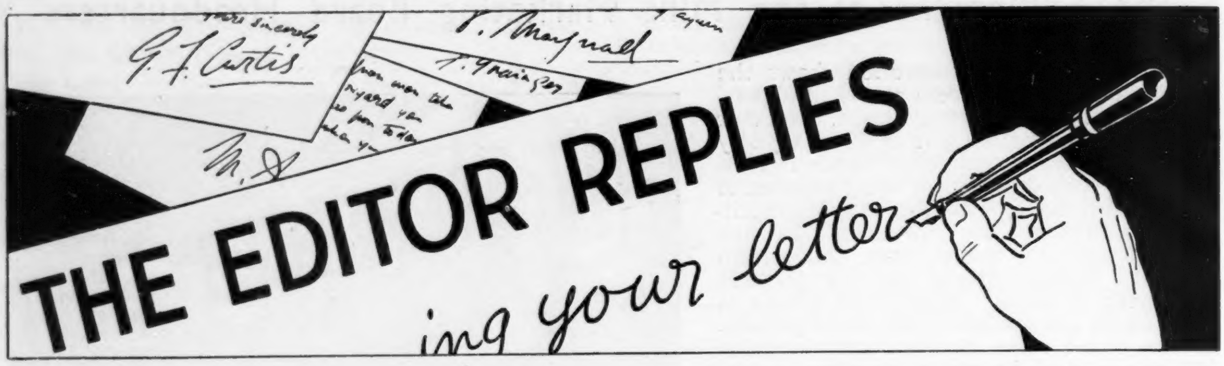
The Illuminating Engineering Society (U.S.A.).

Notes on Transactions (January, 1941)

NEWS: Much attention has been devoted to *fluorescent lighting*. A joint session on this subject has been arranged with the American I.E.E., and a second "fluorescent lighting school" has been organised in Chicago. A meeting of the *Inter-Society Colour Council* is being called to consider various problems. Attention is drawn to the important recognition given to the value of the relighting of factories in Great Britain as an "essential" in war time effort. The conclusions of a group of traffic safety experts in regard to *street accidents in Chicago* are summarised. It is inferred that there are three times as many fatal traffic mishaps per mile of travel at night as in the daylight. Attention is drawn specially to rural roads on which, during 1930 to 1939, night accidents increased by 32 per cent., but day accidents by only 2 per cent. In this period urban night accidents have *decreased* 11 per cent., which is ascribed to the efforts made to secure better lighting in cities.

CONTRIBUTIONS: A lengthy report entitled "*Recommended Practice of Street Lighting,*" prepared by the I.E.S. Committee on Street and Highway Lighting. The purposes of street lighting and methods of promoting good visibility are discussed, and fundamentals are considered. Recommended values of illumination for various types of streets are tabulated and notes are included on the measurement and calculation of street illumination. Of special interest is the diagram showing the proposed distribution of illumination near the entrances to underpasses and tunnels. *The Illuminating Engineering Society's contributions to Improved School Lighting. By H. B. Dates.* Reviews previous codes on school lighting and gives the result of a survey in 1940. From this it is deduced that the average illumination is about 7 ft.c.

It is also mentioned that 12 per cent. of all school lighting installations and 66 per cent. of installations in new schools conform to the recommendations. *The Use of Radiant Energy for the Application of Heat. By H. Haynes.* Describes applications of radiant heat for the evaporation of moisture and discusses the use of incandescent lamps as a source of radiant heat. A new graphical method for estimating the wattage and number of lamps required is presented. The assembly of lamps such as the drying of synthetic lacquer, finishing doors of buildings, etc., is illustrated. *Prediction of Illumination at a Point from Source of Any Shape. By H. H. Higbie.* The method is based upon the projection of the light source to the plane of the ceiling, dividing this plane luminous area (of the same brightness as the source) into straight ribbons by parallel lines and applying to each of these ribbons the formula for illumination from a line source, and then adding the values for all the ribbons. Examples of the practical application of the method are illustrated and discussed. *Operating Advantages of Controlled Conditions Plants. By W. J. Austin.* Discusses the treatment of so-called "windowless" buildings where the control of atmospheric conditions is of outstanding importance. It is pointed out that one cannot rely on natural lighting during the winter periods and that if daylight is shut out and the twenty-four hours responsibility for plant lighting is transferred to electric lights, illuminating engineers have full control and can meet each problem as it arises.



Those who have commented upon the note in our last issue entitled "**Lighting for Obscurity**" may be referred to a further note in the present issue (page 21). It is unnecessary to add to this except, perhaps, to repeat that the policy on such matters as war-time street lighting is naturally based on many other considerations besides the purely technical ones with which illuminating engineers are concerned.

Enquiries in regard to the **photometer** being used by the police in Bedfordshire **to check the candlepower of motor headlights** have brought from Sergeant E. S. Turton, the officer responsible, some description of his methods. The instrument used is an Everett Edgcumbe photometer, with a separate test surface and a scale reading from 0 to 5 ft.c., calibrated at the N.P.L. Its consistency is checked by comparison with a light source in a special box, designed to furnish an illumination of 1 foot-candle. This serves as a species of portable standard, available for daily checking of the photometer. So far the original reading has been preserved without appreciable variation.

It was recently suggested, as a topical subject in these days, that the I.E.S. should devote an evening to **the use of illumination to reveal falling objects!** Apart from special illustrations arising in war time, which could hardly be discussed in public in any detail, there is something in the suggestion, especially if taken in its broadest aspects and applied to **moving objects** in general. What are the laws connecting requisite illumination with the speed of moving objects that are to be identified—such as one meets in games played by artificial light? Or the apparent speed of stationary objects such as name-plates of stations seen from a moving railway train, or objects viewed from a still more rapidly moving aeroplane? This was one of the factors contemplated in the system suggested by Mr. A. W. Beuttell for determining necessary illumination.* It is the one on which least definite knowledge is available.

I have been taken to task for using the term "**supplementary local lighting.**" Is it a fact that the term "local lighting" is obsolete? It describes the concentration of light at a particular spot much better than "supplementary lighting"—for in fact what we call local lighting may furnish *the main illumination*, and it would then be more correct to describe the surrounding subdued general lighting as "supplementary." Apart from this argument there is the question whether by "local lighting" we mean shielded lights placed close to the work—not necessarily the same as **local illumination,** which might be produced by a spotlight some distance away. Evidently there is a need for greater precision in definition.

Some interest has been excited by the **demonstrations** of the comparative ease with which persons in light and dark clothing could be seen against a background intermediate in hue under **war-time street lighting conditions,** as described in our last issue (January, 1941, page 5). It was pointed out at the meeting that the total light reflected, from both object and background, was less when the clothing was dark. It also seemed possible that the cardboard figures, by throwing a shadow on the background (as, of course, might well happen in practice), impaired the contrast. The most likely explanation, however, seems to be that at this very weak illumination the eye fails to respond adequately either to the illuminated figure or the somewhat more brightly lighted background. **Subjective contrast is therefore lost,** even though the physical contrast may be about the same with either set of figures. The point is a curious one, and there seems to be a good deal to be found out in regard to contrast effects at these very weak illuminations. When colour of light is introduced the position may become still more complex. Some readers may recall the late Professor van der Werfhorst's persistently urged contention that with **sodium light** contrasts at weak illuminations were exceptionally vivid owing to the more rapid gain in sensitivity of the eye with increasing stimulus, as compared with greenish-blue light.

My attention has been drawn to the possibilities of using **light sensitive cells** to detect the arrival of **incendiary bombs,** as I understand is done in the Radio-visor system. I should welcome experience of this problem. Everyone who has had experience of fire-watching must have been struck by the waste of time involved in waiting for the inflammatory conditions to arise. Automatic means of signalling such an event might serve to minimise and economise human effort, or at least permit it to be applied under somewhat less arduous conditions.

I have been asked to suggest an **up-to-date book on searchlights.** Is there such a book? Inquiries do not seem to reveal any comprehensive work of recent date, and papers on the subject are few and far between.

* "An Analytical Basis for a Lighting Code," "Illuminating Engineer," Jan., 1934, p.5.

War-time Street Lighting with Gas

Bolton Corporation Lighting Department has practically completed the installation of modified "starlight" street lamps. All main roads, with one small exception, are now lighted, and when the scheme is finished Bolton will have over 1,300 "starlights" in the borough. Some 500 of these will be gas-lighted.

About twenty miles of streets in Burnley are now illuminated with gas "starlighting."

Progress is being made with the extension of modified street lighting in Bradford. In January last year the Gas and Electricity Departments shared the lighting of 1,000 experimental "starlights" in the centre of the city. The lighting is now being extended on all passenger transport routes within Bradford, and the Gas Department has completed the conversion of about 300 of the 400 extra gas lamps required.

Bradford Gas Department is also responsible for the lighting of nearly 500 air-raid shelters and first-aid posts, as well as a number of street signs. In all about 1,400 gas lamps are now in use: about one-tenth of the pre-war total.

Literature on Lighting

(Abstracts of Recent Articles on Illumination and Photometry in the Technical Press)

(Continued from page 16, January, 1941)

II.—PHOTOMETRY.

23. A Daylight Testing Range for Projection Equipment.
Anon. Journal of Scientific Instruments, Vol. XVII., pp. 212-13, August, 1940.

Describes a photoelectric substitution method for candle-power measurements at a range of 1,600 ft, using a compact form of screened receiver which reduces stray light errors to negligible proportions. H. J. T.

24. Report of the Committee (of the Society of Motion Picture Engineers) on Theatre Engineering.
J. Soc. Mot. Pict. Eng., Vol. 35, p. 549, December, 1940.

In dealing with the problem of screen photometry, an attempt is made to organise the system of photometric nomenclature. Definitions of photometric quantities are given, and conversion tables from one system to another are given. R. G. H.

III.—SOURCES OF LIGHT.

25. Electric Discharge Lamps.
C. C. Paterson. Elect., 126, p. 59, January 31, 1941.

Details, with circuit diagram and spectral data, are given for the 80-watt tubular fluorescent lamp. These lamps have proved to be very successful in industrial installations. C. A. M.

26. Projector Lamps.
Anon. El. Rev., Vol. CXXVIII., No. 3,295, p. 251. January 17, 1941.

New types of projector lamp are described which in many cases can replace carbon arcs. Highly refractory glass is used for the bulbs of these high brightness lamps. R. G. H.

27. Filament Design in Projector Lamps.
Anon. Electrical Times, Vol. 99, No. 2,567, p. 15, January 2, 1941.

Details of different filament forms of tungsten projector lamps in relation to various optical systems are discussed and problems of design indicated. W. E. H.

IV.—LIGHTING EQUIPMENT.

28. High-Efficiency Fluorescence.
T. Thorne Baker. El. Rev., Vol. CXXVIII., No. 3,291. p. 158, December 20, 1940.

Explains the mechanism of fluorescence in brief, and gives a summary of the work which has been done on fluorescent materials in order to increase the luminous efficiency of discharge lamps. R. G. H.

29. Head-lamp Mask for Motor Vehicles.
British Standard Specification, BS/ARP 36, January, 1941.

A headlamp mask conforming to this specification will comply with the Lighting (Restrictions) Order when correctly applied and adjusted. The specification, however, goes beyond the Order in giving minimum illumination values Essential constructional features and particulars to be marked on masks are given. The photometric performance is defined and the method of test described. At a distance of 10 ft. the illumination at any angle must not exceed 2.5 ft.c. and it shall not be less than 1.25 at the max. angle. Fuller details in regard to distribution of light are also presented. J. S. D.

30. Low Surface Brightness Attachment for Local Lights.
Anon. The Electrical Times, Vol. 99, No. 2,570, January 23, 1941.

Describes an attachment for local light, by which glare is avoided. A detachable skirt is fitted with a low brightness diffusing screen; the complete skirt is arranged to be readily removable from the fitting. W. E. H.

31. Transmission through Glass at High Temperatures.
A. J. Holland and Prof. W. E. S. Turner. Glass, Vol. 17, No. 3, p. 77, March, 1940.

Spectral transmissions of a number of commercial glasses were measured over a range of temperatures extending up to their softening points. In general, the transmission was found to decrease with increasing temperature and in some cases the spectral position of maximum transmission was moved. W. E. H.

32. Remote Control System at Bedford.
Anon. Electrical Times, Vol. 99, No. 2,569, January 16, 1941.

A description of the apparatus for the remote control of all street lighting in Bedford is given. This has now been adopted for A.R.P. purposes, and includes the control of 2,000 starlight street lamps and "aids to movement" signs. W. E. H.

V.—APPLICATIONS OF LIGHT.

33. Factory Lighting.
J. S. Dow. El. Rev., Vol. CXXVIII., No. 3,295, page 256, January 17, 1941.

New factory lighting legislation to meet war conditions has been governed by the known correlation between greater output, absence of fatigue on the part of the worker, and adequate illumination and absence of glare. The fundamental considerations behind the new regulations are discussed. R. G. H.

34. Speeding Tool Production.
Anon. Elect., 125, p. 270, November 22, 1940.

A brief description is given of the manner in which the use of light from a "black glass" lamp has eased the production of the final finish on tools and gauges. C. A. M.

35. Sodium Street Lighting.
Anon. Elect., 125, p. 321, December 20, 1940.

Details with a photograph are given of an installation of double carriageway street lighting installation in New York using sodium lamps. A system of combined central mounting and double mounting is employed. The width of each roadway is 34 ft. with a central reservation of 10 ft. The average illumination value obtained is 0.72 ft.c. C. A. M.

36. Bridge Lighting in Australia.
Anon. The Electrical Times, Vol. 99, No. 2,569, January 16, 1941.

Particulars of the equipment used for lighting the roadway and footpath of the Storey Bridge in Queensland are given. Sodium lamps are employed throughout. W. E. H.

37. Decorative Lighting To-day.
Anon. The Electrical Times, Vol. 99, No. 2,568, January 9, 1941.

Recent installations of concert hall and hotel lighting are described. The design of the fittings is such as to prevent danger from flying glass during air-raids. W. E. H.

38. Fluorescent "Ceiling" for Pineapple Cannery.
Anon. El. World, 114, p 1186, October 19, 1940.

Details are given of the lighting scheme adopted in an American fruit-canning factory. Fluorescent tubular lamps are used, and experiments were made to determine the best position of the lighting units for good visibility. One important consideration was the blending of the artificial light with daylight, and a further advantage was a reduction of reflected glare from polished metal surfaces. S. S. B.

39. Sports under Artificial Light.
Anon. Elect. 126, p. 37, January 17, 1941.

Details with a photograph are given of an installation of floodlighting a sports field in New Zealand. Steel towers 80 ft. high are used. C. A. M.

40. Advancement in Projection Practice.
F. H. Richardson. J. Soc. Mot. Pict. Eng., Vol. 35, p. 466, November, 1940.

Traces the development of motion picture projection practice from the earliest days to the present day. R. G. H.

Go To It!—With Light

Under this title a recently-issued E.L.M.A. leaflet urges the value of good industrial lighting as an economic necessity.

One important point is that, in the present circumstances, the average age of factory employees tends to rise steadily as more and more men are withdrawn for the Forces. Amongst these older men are to be found some of the most highly skilled and experienced operatives. Yet it must not be forgotten that old eyes need more light than younger ones.

At the other end of the scale we have those in need of specially good lighting for quite different reasons—young women workers transferred from familiar to unfamiliar tasks who need every available advantage to safeguard them and compensate for their initial lack of skill.

Old Eyes need more light, and also good quality of light as well as other aids to vision.

The needs of both classes of workers both as regards quantity and quality of lighting, must be met, if work is not to suffer and needless risk incurred.

The quality of lighting, as well as the amount of light (recommended values will be found in the I.E.S. "code"), are of importance. Daylight conditions may be simulated by the use of large artificial skylights. Surroundings should be treated in light colours so as to diffuse the light and eliminate the depressing "tunnel effect."

(*Continued from page 33.*)

41. Report of the Studio Lighting Committee (of the Society of Motion Picture Engineers).

J. Soc. Mot. Pict., Eng., Vol. 35, p. 607, December, 1940.

Summarises the advances made in studio lighting practice over the past year. No important changes in technique have occurred, but some improvements in equipment are commented on. R. G. H.

42. Report of the Television Committee (of the Society of Motion Picture Engineers).

J. Soc. Mot. Pict. Eng., Vol. 35, p. 569, December, 1940.

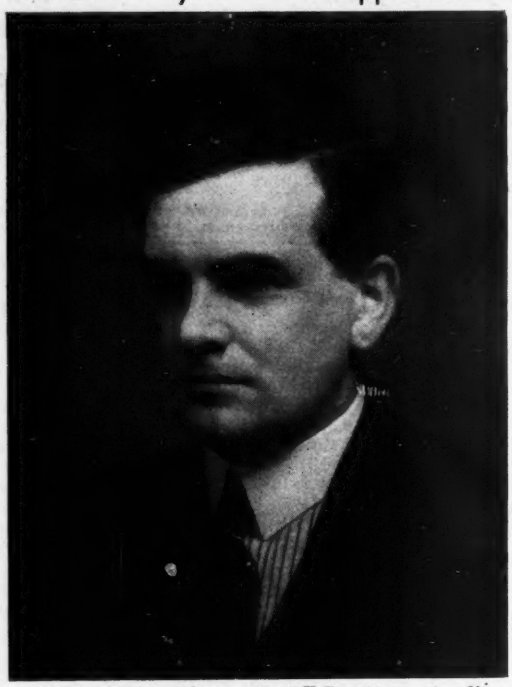
Reports on work done on the problems of flicker and visual fatigue in television viewing, and of the problems of the portrayal of motion. R. G. H.

43. Colour Television.

Anon. El. Rev., Vol. CXXVIII., No. 3,293, p. 207, January 3, 1941.

Describes a demonstration of J. L. Baird's system of colour television. A two-colour process is used, and the image is received on a screen 2 ft. 6 in. by 2 ft. R. G. H.

Mr. L. M. Tye: New Appointment



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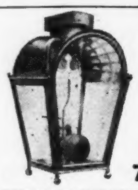

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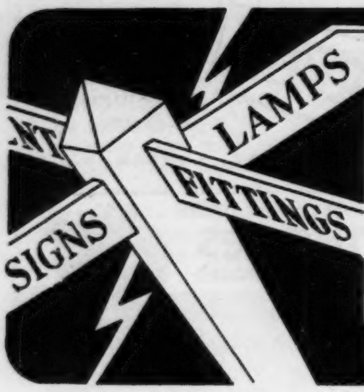
INDEX TO "WHERE TO BUY"

Accessories ... 22
Architectural Lighting ... 6, 13, 14, 18, 25, 26
Automatic Light Control ... 12, 16, 21
Cinema Lighting ... 6, 14, 15, 20, 23, 26
Concrete Pillars, etc. ... 5
Electric Lamps ... 4, 23
Fittings 2, 3, 4, 7, 8, 9, 13, 14, 15, 17, 18, 19, 20, 23, 25, 26, 27, 28, 29
Floodlighting ... 2, 4, 9, 15, 23, 26
Gaslighting ... 17, 27
Glassware ... 15
Industrial Lighting ... 3, 4, 6, 8, 9, 13, 14, 19, 23, 29
Local Lighting ... 19
Photo Electric Cells ... 10, 21
Photometers ... 1, 11
Reflectors ... 3, 4, 7, 8, 9, 15, 23, 25, 28
Signal Lights ... 29
Special Lighting ... 2, 6, 9, 12, 14, 15, 18, 20, 23, 25
Street Lighting Units ... 4, 7, 8, 9, 15, 17, 23, 27
Theatre Lighting ... 2, 14, 23, 26
Time Switches ... 12, 16
Winches and Suspension Gear ... 24

N.B.—The numbers are those attached to individual entries in the Directory
(See pp. 35—36)



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